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THE FEEDING OF FARM ANIMALS.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., December 31, 1894.

SIR: I have the honor to transmit herewith for publication as a Farmers' Bulletin an article on the feeding of farm animals, prepared under my direction by E. W. Allen, Ph. D., assistant director of this Office. In this article the attempt has been made to make a clear and concise explanation of the principles on which the successful feeding of farm animals is based. These principles have been established by feeding experiments and other investigations at experiment stations and similar institutions in Europe and America, combined with observations of the practice of successful feeders. While the rations which may properly be fed to farm animals will necessarily vary with the kinds of feeding stuffs available in different regions and the cost of these materials at different times, a knowledge of the amount of food which animals require when fed for different purposes and the ways in which food materials should be combined to make suitable rations will enable the feeder to secure the most economical and profitable results attainable under the conditions existing in any given time and locality. The present bulletin has been confined to a statement of the general principles of feeding with the expectation that hereafter it may be possible to discuss the application of these principles to different kinds of farm animals in other publications of this series.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

CONTENTS.

THE FEEDING OF FARM ANIMALS.

PRINCIPLES OF FEEDING.

The feeding of farm animals, like the use of fertilizers for crops, rests upon well-defined principles. Our knowledge of these principles has been derived from the studies of the chemist and the animal physiologist on the composition and functions of food and the way it is utilized after it is eaten. These studies have shown that the materials of the body are continually breaking down and being consumed, and that to keep the animal in a healthy and vigorous condition there must be a constant supply of new material. If this is lacking, or is insufficient, hunger and finally death result. To keep up this supply is one of the chief functions of food, but in addition to this the food maintains the heat of the body and at the same time furnishes the force or energy which enables the animal to move the muscles and do work and also to perform the necessary functions of the body. In furnishing heat and energy the food may be said to serve as fuel. If, in addition to repairing the wastes of the system and furnishing it with heat and energy, growth is to be made, as in the case of immature animals, or milk secreted, an additional supply of food is required. To supply food in the right proportion to meet the various requirements of the animal without a waste of food nutrients constitutes scientific feeding. It is by carefully studying the composition of feeding stuffs, the proportion in which they are digested by different animals and under different conditions, and the requirement of animals for the various food nutrients when at rest, at work, giving milk, producing wool, mutton, beef, pork, etc., that the principles of feeding have been worked out. In applying these principles in practice the cost of different feeding stuffs must be taken into account.

COMPOSITION OF THE ANIMAL BODY.

The animal body is made up mainly of four classes of substances—water, ash or mineral ingredients, fat, and nitrogenous matters. The proportion in which these four classes of substances occur depends upon the age of the animal, treatment, purpose for which it is kept, etc.

Water constitutes from 40 to 60 per cent of the body and is an essential part. From 2 to 5 per cent of the weight of the body is ash. This occurs mainly in the bones. The fat varies greatly with the condition of the animal, but seldom falls below 6 per cent or rises above 30 per cent. The nitrogenous materials or protein includes all of the materials

containing nitrogen; all those outside this group are free from nitrogen, or non-nitrogenous. The nitrogen referred to here is the same as that mentioned in connection with fertilizers, and is the element which constitutes about four-fifths of the atmosphere. It occurs in plants and animals in various compounds grouped under the general name of protein. Lean meat, white of the egg, and casein of milk (curd) are familiar forms of protein. The flesh, skin, bones, muscles, internal organs, brain, and nerves—in short, all of the working machinery of the body—are composed very largely of protein. The albuminoids are a class of compounds included under protein.

COMPOSITION OF FEEDING STUFFS.

The food of herbivorous animals contains the same four groups of substances found in the body, viz, water, ash, protein (nitrogenous materials), and fat; and in addition to these a class of materials called carbohydrates, defined below.

Water.—However dry a feeding stuff may appear to be—whether hay, coarse fodder, grain, or meal—it always contains a considerable amount of water which can be driven out by heat. The amount may be only from 8 to 15 pounds per 100 pounds of material, as in hay, straw, or grain, but in corn fodder and silage it amounts to nearly 80 pounds, and in some roots to 90 pounds. This water, although it may add to the palatability of a food, is of no more benefit to the animal than water which it drinks, and from which the chief supply is derived. For this reason, and because the proportion of water varies very widely, comparisons of different kinds of foods are usually made on a dry or water-free basis which shows the percentage of food ingredients in the dry matter.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorine, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. From the ash constituents of the food the animal selects those which it needs and the rest is voided in the manure. As a general rule rations composed of a variety of nutritious foods contain sufficient ash to supply the requirements of the body. Corn, however, is poor in ash, and when fed extensively may need to have added to it additional ash material, as wood ashes, charcoal, or bone meal.

Fat, or the materials dissolved from a feeding stuff by ether, includes, besides real fats, wax, the green coloring matter of plants, etc. For this reason the ether extract is usually designated *crude* fat. The fat of food is either stored up in the body as fat or burned to furnish heat and energy.

Carbohydrates are usually divided into two groups, nitrogen-free extract, including starch, sugar, gums, and the like, and cellulose or fiber, the essential constituent of the walls of vegetable cells. Cotton fiber and wood pulp are nearly pure cellulose. Coarse fodders, like hay and straw, contain a large proportion of fiber, while most grains contain little fiber, but are rich in starch, sugar, etc. (nitrogen-free extract). The carbohydrates form the largest part of all vegetable foods. They are not permanently stored up as such in the animal body, but are either stored up as fat or burned in the system to produce heat and energy. They are one of the principal sources of animal fat.

Protein (or nitrogenous materials) is the name of a group of materials containing nitrogen. All other constituents of feeding stuffs, the ash, fat, and carbohydrates, are non-nitrogenous or free from nitrogen. Protein materials are often designated as "flesh formers," because they furnish the materials for the lean flesh; but they also enter largely into the composition of blood, skin, muscles, tendons, nerves, hair, horns, wool, and the casein and albumen of milk, etc. For the formation of these materials protein is absolutely indispensable. No substances free from nitrogen can be worked over into protein, or fill the place of protein. It is, then, absolutely necessary for an animal to be provided with a certain amount of protein in order to grow or maintain existence. Under certain conditions it is believed protein may be a source of fat in the body; and finally it may be burned, like the carbohydrates and fat, yielding heat and energy.

The sources of heat and energy in the animal, then, are the protein, fat, and carbohydrates of the food and the fat and protein of the body, for the fat and protein of the body may be burned like that in the food. The value of the fat for producing heat is nearly two and a half times that of carbohydrates or protein. The sources of fat in the body are the fat, carbohydrates, and, probably, the protein of the food; and the exclusive source of protein in the body is the protein in the food. These groups of food materials are termed nutrients, as they furnish the nutriment of the body.

The composition of feeding stuffs, or the proportion in which the nutrients occur, is determined by chemical analysis. A large number of analyses of American feeding stuffs have been made. These analyses have been compiled, and are summarized in the tables given at the end of this bulletin. These tables show the average composition of a large number of feeding stuffs in common use, together with the limits within which the composition has been found to vary. These maximum, minmum, and average results are given for the foods as they are fed (green or dry). The carbohydrates have here been divided into the two groups mentioned above, viz, fiber and nitrogen-free extract, as they are determined separately. The sum of the two gives the total carbohydrates. In the last column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

These tables show how great are the differences in composition between different kinds of feeding stuffs. Take the case of protein, for instance. In straw this varies from 3 to 4 per cent; in hay of grasses from 6 to 8 per cent; in hay of clovers, cowpeas, and the like from 12 to 16 per cent; in grains from 10½ to 12½ per cent; and in by-products it reaches 33 per cent in linseed meal, 42 per cent in cotton-seed meal, and 47½ per cent in peanut meal. Protein, like its counterpart, the nitrogen in fertilizers, is the most expensive element, and a considerable amount of it is absolutely essential to growth. The tables will aid in the selection of the cheapest sources of food materials.

DIGESTIBILITY OF FEEDING STUFFS.

The tables just referred to give the total amounts of nutrients found by analysis in different feeding stuffs. But only a portion of these amounts is of direct use to the animal, i. e., only that digested. A part of the food is dissolved and otherwise altered by the juices of the mouth, stomach, and intestines, absorbed from the alimentary canal, and in the form of chyle passes into the blood and finally serves to nourish and sustain the body. This portion is said to be digested and assimilated, and from it alone the animal is nourished. The other portion, the part not digested, passes on through the body and is excreted as manure.

As the rates of digestibility are not constant for different foods, and as only the digestible portion is of any nutritive use to the animal, it is essential to know in the case of each feeding stuff what part of its protein, fat, and carbohydrates (the total quantity of which is shown by analysis) is actually digested by the animal. This is determined by digestion experiments with animals, and to secure approximately accurate figures the trials are repeated with a large number of animals and under various conditions. The figures obtained represent the percentages of the nutrients digested and are called digestion coefficients.

In the case of wheat straw, for instance, on an average 23.4 per cent of the protein which it contains, 35.6 per cent of the fat, 55.5 per cent of the fiber, and 38.7 per cent of the nitrogen-free extract, is digested by cows. The table of composition shows wheat straw to average 3.4 per cent of protein, or 3.4 pounds of protein in 100 pounds of straw. As only 23.43 per cent of this is digestible, 100 pounds of straw would contain only 0.8 pound of digestible protein. The remaining 2.6 pounds of protein are voided and do not aid in nourishing the animal. The amounts of digestible fat and carbohydrates (fiber and nitrogen-free extract) are calculated in a similar way. The digestibility of such coarse fodders as straw, coarse hay, etc., is relatively low. The digestibility, like the composition, varies for the same kind of feeding stuff grown under different conditions and fed to different animals.

AMOUNTS OF DIGESTIBLE NUTRIENTS IN DIFFERENT FEEDING STUFFS.

To simplify matters for the farmer, calculations have been made of the amounts of digestible protein, fat, and carbohydrates contained in 100 pounds each of a large number of more commonly used feeding stuffs. As has been fully explained above, they are derived from averages of composition and of digestibility, both of which are subject to considerable variation. In calculating them American analyses and digestion coefficients found in American experiments were used as far as possible. They are the figures which the farmer has to consult to find the food value of a material in selecting his feeding stuffs or making up a ration.

Dry matter and digestible food ingredients in 100 pounds of feeding stuffs.

Feeding stuff.	Dry matter.	Protein.	Carbo-hydrates.	Fat.	Fuel value.
Green fodder:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Corn fodder[1] (average of all varieties)	20.7	1.10	12.08	0.37	26,076
Rye fodder	23.4	2.05	14.11	0.44	31,914
Oat fodder	37.8	2.69	22.66	1.04	51,624
Redtop, in bloom	34.7	2.06	21.24	0.58	45,785
Orchard grass, in bloom	27.0	1.91	15.91	0.58	35,593
Meadow fescue, in bloom	30.1	1.49	16.78	0.42	34,755
Timothy,[2] at different stages	38.4	2.28	23.71	0.77	51,591
Kentucky blue grass	34.9	3.01	19.83	0.83	45,985
Hungarian grass	28.9	1.92	15.63	0.36	34,162
Red clover, at different stages	29.2	3.07	14.82	0.69	36,187
Crimson clover	19.3	2.16	9.31	0.44	23,191
Alfalfa,[3] at different stages	28.2	3.89	11.20	0.41	29,798
Cowpea	16.4	1.68	8.08	0.25	19,209
Soja bean	28.5	2.79	11.82	0.63	29,833
Corn silage	20.9	0.56	11.79	0.65	25,714
Corn fodder,[1] field cured	57.8	2.48	33.38	1.15	71,554
Corn stover, field cured	59.5	1.98	33.16	0.57	67,766
Hay from—					
Orchard grass	90.1	4.78	41.99	1.40	92,900
Redtop	91.1	4.82	46.83	0.95	100,078
Timothy[2] (all analyses)	86.8	2.89	43.72	1.43	92,729
Kentucky blue grass	78.8	4.76	37.33	1.95	86,516
Hungarian grass	92.3	4.50	51.67	1.34	110,131
Meadow fescue	80.0	4.20	43.34	1.73	95,725
Mixed grasses	87.1	4.22	43.26	1.33	93,925
Rowen (mixed)	83.4	7.19	41.20	1.43	96,040
Mixed grasses and clover	87.1	6.16	42.71	1.46	97,059
Red clover	84.7	6.58	35.35	1.66	84,995
Alsike clover	90.3	8.15	41.70	1.36	98,460
White clover	90.3	11.46	41.82	1.48	105,346
Crimson clover	91.4	10.49	38.13	1.29	95,877
Alfalfa[3]	91.6	10.58	37.33	1.38	94,936
Cowpea	89.3	10.79	38.40	1.51	97,865
Soja bean	88.7	10.78	38.72	1.54	98,568
Wheat straw	90.4	0.80	37.94	0.46	73,998
Rye straw	92.9	0.74	42.71	0.35	82,294
Oat straw	90.8	1.58	41.63	0.74	83,493
Soja-bean straw	89.9	2.30	39.98	1.03	82,987
Roots and tubers:					
Potatoes	21.1	1.27	15.59	....	31,360
Beets	13.0	1.21	8.84	0.05	18,904
Mangel-wurzels	9.1	1.03	5.65	0.11	12,888
Turnips	9.5	0.81	6.46	0.11	13,986
Ruta-bagas	11.4	0.88	7.74	0.11	16,497
Carrots	11.4	0.81	7.83	0.22	16,999
Grains and other seeds:					
Corn (average of dent and flint)	89.1	7.92	66.69	4.28	156,836
Barley	89.1	8.69	64.83	1.60	143,499
Oats	89.0	9.25	48.34	4.18	124,757
Rye	88.4	9.12	69.73	1.36	152,400
Wheat (all varieties)	89.5	10.23	69.21	1.68	154,848
Cotton seed (whole)	89.7	11.08	33.13	18.44	160,047

[1] Corn fodder is entire plant, usually sown thick. [2] Herd's grass of New England and New York.
[3] Lucern.

Digestible food ingredients in 100 pounds of feeding stuffs—Continued.

Feeding stuff.	Dry matter.	Protein.	Carbo hydrates.	Fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Mill products:					
Corn meal	85.0	7.01	65.29	3.25	143,026
Corn-and-cob meal	84.9	6.46	56.28	2.87	128,808
Oatmeal	92.1	11.53	52.06	5.93	143,302
Barley meal	88.1	7.36	62.88	1.96	138,818
Ground corn and oats, equal parts	88.1	7.39	61.20	3.72	143,276
Pea meal	89.5	16.77	51.78	0.65	130,248
Waste products:					
Gluten feed	92.2	20.40	43.75	8.59	155,569
Gluten meal	91.2	25.49	42.32	10.38	169,930
Hominy chops	88.9	7.45	55.24	6.81	145,342
Malt sprouts	89.8	18.72	43.50	1.16	120,624
Brewers' grains (wet)	24.3	4.00	9.37	1.38	30,692
Brewers' grains (dried)	91.1	14.73	36.60	4.82	115,814
Rye bran	88.4	11.45	50.28	1.96	123,089
Wheat bran, all analyses	88.5	12.01	41.23	2.87	111,138
Wheat middlings	84.0	12.79	53.15	3.40	136,996
Wheat shorts	88.2	12.22	49.98	3.83	131,855
Buckwheat middlings	86.8	17.34	26.58	4.54	100,850
Cotton-seed meal	91.8	37.01	16.52	12.58	152,653
Cotton-seed hulls	88.9	0.42	30.95	1.69	65,480
Linseed meal (old process)	90.8	28.76	32.81	7.06	144,313
Linseed meal (new process)	89.8	27.89	36.36	2.73	131,026
Peanut meal	89.3	42.94	22.82	6.86	151,263
Milk and its by-products:					
Whole milk	12.8	3.48	4.77	3.70	30,865
Skim milk—cream raised by setting	9.6	3.13	4.69	0.88	18,048
cream raised by separator	9.4	2.94	5.24	0.29	16,439
Buttermilk	9.9	3.87	4.00	1.06	37,685
Whey	6.6	0.84	4.74	0.31	11,687

The last column in the above table, headed "fuel value," indicates the heat and energy power of the food. It will be remembered that one of the primary functions of the food is to produce heat for the body and energy for work. The value of food for this purpose is measured in "heat units" or "calories,"[1] and is calculated from the nutrients digested. Thus the fuel value of 1 pound of digestible fat is estimated to be 4,220 calories, and of 1 pound of digestible protein or carbohydrates about 1,860 calories. The total fuel value of a feeding stuff is found by using these factors.

The meaning of the figures in the above table is that in 100 pounds of green corn fodder containing an average amount of dry matter (20.7 pounds) there are contained approximately 1.10 pounds of digestible protein (materials containing nitrogen), 12.08 pounds of digestible carbohydrates (starch, sugar, fiber, etc.), and 0.37 pound of digestible fat;

[1] A calorie of heat is the amount required to raise the temperature of a pound of water about 4° F.

and that these materials when burned in the body will yield 26,076 calories of heat, furnishing energy for work and maintaining the temperature of the body.

FEEDING STANDARDS FOR DIFFERENT KINDS OF ANIMALS.

It will be remembered that the primary functions of food are to repair the waste of the body, to promote growth in immature animals, and to furnish heat and energy. And for these purposes only the digestible portion of the food, as given in the above table, is to be taken into account. The amount of digestible protein, fat, and carbohydrates in a ration is an indication of its fitness to fulfill these purposes. The next question is, How much of these materials does an animal require, and in what proportion should they be given? This differs with the purpose for which the animal is kept, whether it is growing, being fattened, used for work, or making milk. An ox standing in the stall requires less food nutrients than one which is worked hard every day. That is, in drawing heavy loads the animal breaks down a certain amount of muscular tissue, which must be replaced by protein in the food, and it uses energy or force which is also furnished by the food nutrients. In standing in the barn it still requires some protein, fat, and carbohydrates to perform the necessary functions of the body, as digestion, to maintain heat in winter, to grow a new coat of hair, etc. But if it is fed the same ration as when working hard the tendency is to get fat.

The cow requires not only materials for maintenance but must also have protein, fat, and carbohydrates to make milk from. The milk contains water, fat, protein (casein, or curd), sugar, and ash, and these are all made from the constituents of the food. If insufficient protein, fat, and carbohydrates are contained in the food given her, the cow supplies this deficiency for a time by drawing on her own body, and gradually begins to shrink in quantity or quality of milk, or both. The stingy feeder cheats himself as well as the cow. She suffers from hunger, although her belly is full of swale hay, but she also becomes poor and does not yield the milk and butter she should. Her milk glands are a wonderful machine, but they can not make milk casein (curd) out of the carbohydrates in coarse, unappetizing, indigestible swale hay or sawdust any more than the farmer himself can make butter from skim milk. She must not only have a generous supply of good food but it must contain sufficient amounts of the nutrients needed for making milk. Until this fact is understood and appreciated, successful, profitable dairying is out of the question. The cow must be regarded as a sort of living machine. She takes the raw materials given her in the form of food and works them over into milk. If the supply of proper materials is small, the output will be small. The cow that will not repay generous feeding should be disposed of at once and one bought that will. There are certain inbred characteristics which even liberal feeding can not overcome.

Attempts have been made to ascertain the food requirements of various kinds of farm animals under different conditions. Large numbers of feeding experiments have been made under varying conditions with this end in view. From the results feeding standards have been worked out which show the amounts of digestible protein, fat, and carbohydrates supposed to be best adapted to different animals when kept for different purposes. The feeding standards of Wolff, a German, have been most widely used. They are as follows:

Wolff's feeding standards.

A.—PER DAY AND PER 1,000 POUNDS LIVE WEIGHT.

	Total organic matter.	Digestible food materials.			Fuel value.
		Protein.	Carbohydrates.	Fat.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Oxen at rest in stall	17.5	0.7	8.0	0.15	16,815
Wool sheep, coarser breeds	20.0	1.2	10.3	0.20	22,235
Wool sheep, finer breeds	22.5	1.5	11.4	0.25	25,050
Oxen moderately worked	24.0	1.6	11.3	0.30	24,260
Oxen heavily worked	26.0	2.4	13.2	0.50	31,126
Horses moderately worked	22.5	1.8	11.2	0.60	26,712
Horses heavily worked	25.5	2.8	13.4	0.80	33,568
Milch cows	24.0	2.5	12.5	0.40	29,590
Fattening steers:					
First period	27.0	2.5	15.0	0.50	34,660
Second period	26.0	3.0	14.8	0.70	36,062
Third period	25.0	2.7	14.8	0.60	35,082
Fattening sheep:					
First period	26.0	3.0	15.2	0.50	35,962
Second period	25.0	3.5	14.4	0.60	35,826
Fattening swine:					
First period	36.0	5.0	27.5		60,450
Second period	31.0	4.0	24.0		52,080
Third period	23.5	2.7	17.5		37,570

B.—PER DAY AND PER HEAD.

	Average live weight per head.	Total organic matter.	Digestible food materials.			Fuel value.
			Protein.	Carbohydrates.	Fat.	
Growing cattle:						
Age—	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
2 to 3 months	150	3.3	0.6	2.1	0.30	5,116
3 to 6 months	300	7.0	1.0	4.1	0.30	10,750
6 to 12 months	500	12.0	1.3	6.8	0.30	16,332
12 to 18 months	700	16.8	1.4	9.1	0.28	20,712
18 to 24 months	850	20.4	1.4	10.3	0.26	22,859
Growing sheep:						
Age—						
5 to 6 months	56	1.6	0.18	0.87	0.045	2,143
6 to 8 months	67	1.7	0.17	0.85	0.040	2,066
8 to 11 months	75	1.7	0.16	0.85	0.037	2,035
11 to 15 months	82	1.8	0.14	0.89	0.032	2,051
15 to 20 months	85	1.9	0.12	0.88	0.025	1,966
Growing fat swine:						
Age—						
2 to 3 months	50	2.1	0.38	1.50		3,496
3 to 5 months	100	3.4	0.50	2.50		5,580
5 to 6 months	125	3.9	0.54	2.96		6,510
6 to 8 months	170	4.6	0.58	3.47		7,533
8 to 12 months	250	5.2	0.62	4.05		8,686

For an unworked ox of 1,000 pounds this standard calls for 0.7 pound of digestible protein, 8 pounds of digestible carbohydrates, and 0.15 pound of digestible fat, which would furnish 16,815 calories of heat and energy. When heavily worked the same ox would require, according to the standard, food with three times as much protein and of

nearly twice the fuel value. A cow giving milk would require as much protein and nearly as much carbohydrates and fat as the heavily-worked ox. A ration furnishing the protein, fat, and carbohydrates in the right proportion is said to be a "balanced" ration. If it contains too much carbohydrates and too little protein it is not well balanced.

In addition to furnishing the requisite amounts of nutrients the food must have a certain bulk. This bulkiness is brought about by feeding a certain amount of coarse fodder, which aids digestion and helps to keep the animal satisfied and healthy. The measure of the bulk is the amount of dry matter or organic matter in the ration. The dry matter is the solid or water-free portion of the food. The organic matter is the combustible portion—that is, the dry matter less the mineral matter or ash. These two do not differ very widely from each other in most feeding stuffs. The standard calls for 24 pounds of organic matter for a cow, but this may vary considerably without serious results. More latitude is allowable than in the case of any single nutrient.

VALUE OF FEEDING STANDARDS.

It should be borne in mind that a feeding standard is simply a concise statement of the results of experiments and observations. Hence its application is to the average conditions. No single fixed standard can be laid down for all conditions. It is intended simply as an aid to rational feeding, and must be used in connection with intelligent observation on the part of the feeder. It has been claimed by some that the standards of Wolff do not apply to our conditions, that they are too high in protein. As a rule they call for a somewhat larger amount of protein in proportion to the carbohydrates and fat than is given by many successful feeders in this country, especially for dairy cows. This fact has been brought out by statistics collected by the experiment stations of New York (State), Wisconsin, and Connecticut (Storrs). The Wisconsin Station collected the rations fed by 128 successful dairymen and breeders in different parts of the United States and calculated the digestible nutrients in them. While they varied very widely, the average per day and per cow was found to be 24.51 pounds of dry matter, 2.15 pounds of digestible protein, 13.27 pounds of digestible carbohydrates, and 0.74 pound of digestible fat, with a fuel value of 31,250 calories. The average of 16 rations fed in Connecticut, as reported by the Connecticut Storrs Station, was 2.48 pounds of digestible protein, 14.09 pounds of carbohydrates, and 0.94 pound of fat, with a fuel value of 34,800 calories. It is believed, however, that the standards proposed by Wolff are not very far from correct, and are the best we have at present. They have a value for farmers in indicating approximately the amounts of nutrients required under different conditions, and enabling them to make up rations. Experience will demonstrate to the dairyman whether a ration as rich in protein as Wolff's standard is best adapted to his conditions, or whether one containing the amount suggested by the Wisconsin Station is equally good.

CALCULATION OF RATIONS.

The calculation of rations with the aid of the tables already given will prove both interesting and profitable, for it will throw much light on the proper combinations of food for different purposes. At the same time it promotes a spirit of inquiry and close observation on the part of the farmer, which is one of the requisites of a successful feeder. Wolff's standard for a cow of 1,000 pounds calls for 2.5 pounds of protein, 12.5 pounds of carbohydrates, and 0.4 pound of fat, which would furnish 29,590 calories of heat. A ration can be made up furnishing approximately these amounts of carbohydrates and fat, but as they serve practically the same purpose in nutrition an excess of one may make up for a slight deficiency of the other.

RATION FOR A DAIRY COW.

Let us calculate the daily ration for a cow, assuming that the farmer has on hand clover hay, corn silage, corn meal, and wheat bran. From the table showing the amounts of digestible nutrients (p. 7) we find that 100 pounds of clover hay furnishes 84.7 pounds of dry matter, 6.58 pounds of protein, 35.35 pounds of carbohydrates, and 1.66 pounds of fat, equivalent to a fuel value of 84,995 calories. Twelve pounds would have 10.16 pounds of dry matter, 0.79 pound of protein, 4.24 pounds of carbohydrates, and 0.20 pound of fat, giving a fuel value of 10,199 calories. In the same way the amounts furnished by 20 pounds of corn silage, 4 pounds of corn meal, and 4 pounds of wheat bran are found. The result would be the following table:

Method of calculating ration for dairy cow.

	Total dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
12 pounds of clover hay	10.16	0.79	4.24	0.20	10,199
20 pounds of corn silage	4.18	0.11	2.36	0.13	5,143
4 pounds of corn meal	3.40	0.28	2.61	0.13	5,921
4 pounds of wheat bran	3.54	0.48	1.65	0.11	4,446
Total	21.28	1.66	10.86	0.57	25,709
Wolff's standard	24.00	2.50	12.50	0.40	29,590

This ration is below the standard, especially in protein. To furnish the protein needed without increasing the other nutrients too much, a feeding stuff quite rich in protein is needed. The addition of 4 pounds of gluten feed would make the ration contain:

Completed ration for dairy cow.

	Total dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
12 pounds clover hay, 20 pounds corn silage, 4 pounds corn meal, and 4 pounds wheat bran	21.28	1.66	10.86	0.57	25,709
4 pounds gluten feed	3.69	0.82	1.75	0.34	6,223
Total	24.97	2.48	12.61	0.91	31,932

This ration, it will be seen, contains somewhat more carbohydrates and fat than the standard calls for.

Since the prime objects of food are to repair the waste of the body (or promote growth) and produce heat and energy, the calculation may be considerably simplified by considering only the protein and the fuel value, without impairing accuracy. For example, suppose the farmer feeds his cows dry corn fodder (not stover), good timothy hay (Herd's grass), and a grain mixture composed of equal parts of corn meal, wheat bran, and gluten meal. A ration might be made from these as follows:

Ration per cow daily.

	Dry matter.	Protein.	Fuel value.
	Pounds.	*Pounds.*	*Calories.*
10 pounds timothy hay	8.68	0.30	9,273
10 pounds dry corn fodder	5.78	0.25	7,155
4 pounds corn meal	3.40	0.28	5,921
4 pounds wheat bran	3.54	0.48	4,446
4 pounds gluten meal	3.62	1.02	6,797
Total	25.02	2.33	33,592

This ration is higher than the standard in fuel value, owing to richness of the materials in carbohydrates and fat, and slightly lower in protein. The substitution of 1 pound of new-process linseed meal in place of 1 pound of the corn meal would give 0.21 pound more protein, which would make the ration contain 2.54 pounds of protein.

In calculating rations it is necessary to use weights rather than measures, as the analyses and tables are made on the basis of weight. As the farmer measures the grain given it will be necessary to ascertain the relation between the amount to be given and its measure.

RATION FOR STEERS.

A common practice in fattening steers in the South is to feed 15 to 24 pounds of cotton-seed hulls and 6 to 8 pounds of cotton-seed meal. The nutrients contained in such mixtures are compared with the standard in the following table:

Rations fed to steers in the South.

	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
20 pounds hulls and 6 pounds cotton-seed meal	23.39	2.30	7.18	1.09	22,255
20 pounds hulls and 8 pounds cotton-seed meal	25.12	3.04	7.51	1.35	25,308
24 pounds hulls and 6 pounds cotton-seed meal	26.85	2.32	8.42	1.16	24,874
24 pounds hulls and 8 pounds cotton-seed meal	28.68	3.06	8.75	1.42	27,927
Wolff's standard:					
First period	27.00	2.50	15.00	0.50	34,660
Second period	26.00	3.00	14.80	0.70	36,062
Third period	25.00	2.70	14.80	0.60	35,082

The trouble with these rations is that they are all too nitrogenous, i. e., contain too much protein in proportion to the carbohydrates and fat. The hulls give bulk to the ration but do not furnish as much carbohydrates and fat as is required of a coarse fodder when fed with so rich a feed as cotton-seed meal. The rations could be improved by substituting 2 pounds of corn meal in place of an equal amount of cotton-seed meal, or by substituting silage for a part of the hulls. The composition would then be:

Rations for steers in the South.

	Dry matter.	Digestible protein.	Fuel value.
	Pounds.	*Pounds.*	*Calories.*
20 pounds hulls, 6 pounds cotton-seed meal, and 2 pounds corn meal	24.99	2.44	25,215
24 pounds hulls, 6 pounds cotton-seed meal, and 2 pounds corn meal	28.55	2.46	27,834
15 pounds hulls, 15 pounds silage, 6 pounds cotton-seed meal, and 2 pounds corn meal	23.69	2.50	25,798
15 pounds hulls, 20 pounds silage, 6 pounds cotton-seed meal, and 2 pounds corn meal	24.73	2.52	27,084

The addition of 2 pounds more of corn meal to these rations would make them better balanced. Whether or not the use of corn meal will prove profitable will depend largely upon the relative prices of cotton-seed meal, hulls, and corn.

For other sections of the country the following ration practically fulfills the requirements of the standard:

Calculating rations for steers.

	Dry matter.	Digestible protein.	Fuel value.
	Pounds.	*Pounds.*	*Calories.*
10 pounds shelled corn	8.9	0.79	15,683
5 pounds wheat bran	4.4	0.60	6,850
4 pounds linseed meal (new process)	3.6	1.12	5,241
10 pounds corn fodder (dry)	5.8	0.25	7,155
3 pounds wheat straw	2.7	0.02	2,220
Total	25.4	2.78	37,149

The 10 pounds of corn fodder may be replaced by 25 pounds of corn silage without materially changing the composition of the ration.

RATION FOR PIGS.

As a result of experiments which have been in progress for several years at the Massachusetts State Station, the station recommends the following proportions of skim milk and corn meal, according to the weight of the pig:

Pigs weighing 20 to 70 pounds, 2 ounces of corn meal per quart of skim milk.
Pigs weighing 70 to 130 pounds, 4 ounces of corn meal per quart of skim milk.
Pigs weighing 130 to 200 pounds, 6 ounces of corn meal per quart of skim milk.

The pigs are fed all they will eat up clean. A ration of 5 quarts of skim milk raised by setting and 20 ounces of corn meal for a pig in the first period, up to 70 pounds weight, would furnish approximately:

Nutrients in ration for young pigs.

	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
10 pounds of skim milk	0.96	0.31	0.47	0.08	1,805
1¼ pounds corn meal	1.06	0.09	0.82	0.04	1,850
Total	2.02	0.40	1.29	0.12	3,655
Standard for pig weighing 50 pounds	2.10	0.38	1.50		3,490

Buttermilk might be used in place of skim milk, but pound for pound it has not usually given quite as good results as skim milk.

SELECTION OF FEEDING STUFFS.

In selecting feeding stuffs for his stock the farmer will naturally be governed by the conditions of the market. The cost of feeding stuffs is controlled by other factors than the actual amounts of food materials which they contain; in deed, there often appears to be very little con nection between the two. Bearing in mind that the protein is the most expensive ingredient, the farmer can make his selection with the aid of the tables showing the digestible materials in 100 pounds. These will show him whether wheat at 50 cents per bushel is a cheaper feed than corn at 60 cents, and how gluten meal at $23 per ton compares with linseed meal at $27. In these comparisons only the protein and fuel value need necessarily be considered. Of course, the special adaptability and the reverse of some materials to different kinds of animals will be taken into account.

But another important consideration where fertilizers or manures have to be relied upon is the manurial value of a feeding stuff. This is shown by the nitrogen in the protein and the phosphoric acid and potash in the ash. Feeding stuffs differ widely in this respect, wheat bran and cotton-seed meal having a high manurial value, while corn meal is relatively low. The value of the manure is largely determined by the character of the food given. If the manure is carefully preserved a large proportion of the fertilizing constituents of the food are recovered in the manure, and go to enrich the land. This matter has been treated in a separate bulletin on barnyard manure.[1]

It will be seen by referring to the table of feeding stuffs given above that hay from the leguminous crops—clovers, lupines, alfalfa, cowpea, etc.—contains about twice the quantity of digestible protein that hay from the grasses does. As a result they contain much more nitrogen for fertilizing purposes, and they are also somewhat richer in potash than grasses. The seeds of these plants (cowpea, soja bean, etc.) are

[1] Farmers' Bulletin No. 21.

exceedingly rich in protein and can take the place of expensive commercial feeds. By growing and feeding more leguminous crops the amount of grain required is diminished, the value of the manure is increased, and the soil is enriched in fertility. Further than this, it has been demonstrated within the last few years that leguminous crops are able to derive the larger part of this nitrogen from the atmosphere during their growth, requiring little manuring with nitrogenous manures. They therefore enrich the soil, the ration, and the manure in nitrogen which they derive from the atmosphere without cost to the farmer, besides improving the mechanical and physical condition of the soil.[1]

ORIGIN OF BY-PRODUCTS USED AS FEEDING STUFFS.

The by-products resulting in the manufacture of flour, glucose, starch, fermented liquors, etc., are extensively used for feeding purposes, and include many of the richest and most prized feeding stuffs. The manner in which these materials are produced will be briefly described.

By-products from flouring mills.—In the modern processes of making flour from wheat the grain is subjected to successive crushings or grindings. After each of these the products are separated by screening and blowing into flour, middlings, and bran. The bran consists of the coarser parts of the husk, which are unfit for further grinding, with portions of the gluten layer. The middlings contain small particles of bran as admixtures. These are separated, and go under the name of shorts. The shorts contain less fiber and ash than the bran, although they are of similar origin—the outer coats of the grain. After cleaning, the middlings are graded and reground to flour.

By-products of similar nature result in the milling of rye, buckwheat, rice, etc.

Hominy chop, meal, and feed result in the manufacture of hominy, and contain the germ and coarser portions of the corn.

By-products from glucose and starch factories.—These include so-called gluten meal, glucose meal, cream gluten, gluten flour, gluten feed, glucose feed, dried sugar feed or meal, maize feed, dried starch feed, and some other materials of similar nature. These are all obtained as by-products in the manufacture of starch and glucose from the starch of corn. The process followed and the treatment of the by-products differs considerably in different factories, which accounts for the wide variation in their composition.

The corn is soaked until it is swollen and soft, and is passed through the mill while wet, the hulls and germs of the corn being rubbed off. In some cases the starch is separated from this mass by means of running water, and the wet residue is dried and sold as gluten feed. In other cases the mass after grinding is bolted, the starch and gluten passing through while the husk and germ remain behind. In some factories the latter (husk and germ) are dried and sold as corn-germ feed, corn-germ meal, etc. In others the material is treated to extract the oil from the germ and then sold under the name of maize feed. The material which passes the bolting cloth is treated to separate most of the starch, and the residue is sold as gluten meal, cream gluten, etc.

[1] See also Farmers' Bulletin No. 16, Leguminous Crops for Green Manuring and for Feeding, by the author of this bulletin.

The Chicago gluten meal, it is said, has had a part of the fat extracted from it. In some cases the gluten meal is mixed with the hulls and germs without the oil being extracted. This is said to be the case with Buffalo gluten feed. These materials should not be confused with "grano gluten," which is a dried distillery refuse.

The residues from these factories are frequently sold in their wet condition, containing from 60 to 70 per cent of water, under the names wet starch feed, sugar feed, glucose feed, etc. These wet products must be used at once, as they ferment. The dried products from the same factory often vary considerably in composition from time to time. Owing to these variations and the fact that there is such a variety of names for these products that it is difficult to make any helpful classification, the farmer can only be certain of what he is buying when he buys on a guaranty of composition or from lots that have been analyzed.

By-products from oil mills.—Of these the most common in this country are the cotton-seed meal and linseed meal. The oil is expressed from the seed, and the residue is in the form of hard cakes called oil cakes. In Europe this cake is often sold as such for feeding. In this country it is usually ground to a meal. Formerly the hulls were not removed from the kernel, and the cake or meal was then known as undecorticated. At present practically all of the cotton seed is decorticated.

The composition of cotton-seed meal depends upon the composition of the seed and the completeness of the separation of the hulls and the expression of the oil. The composition of the hulls depends considerably upon the thoroughness with which the kernel and lint are removed. Usually more or less of the kernel adheres to the hulls, increasing the percentage of protein and fat. Linseed meal, or oil meal, as it is often called, is the residue from the separation of oil from flax seed, and is distinguished as old process and new process. In the old process the oil is expressed. In the new process it is more thoroughly removed with the aid of solvents, hence the meal contains less fat.

By-products from breweries and distilleries.—In making malted liquors from grain (usually barley) the material is treated with malt, changing the starch of the grain to sugar, which is then fermented, yielding alcohol. The residue of the grain is called brewers' grains. As first obtained it is very wet, containing some 75 per cent of water. It is sometimes sold in this condition for immediate use, but when it is to be shipped away is dried, and can then be kept indefinitely.

Malt sprouts, another product from breweries, result in the preparation of malt from barley. The barley is sprouted to develop the principle of malt in the grain, and when the process has proceeded far enough it is checked and the sprouts are broken off and sold for feed. The residue from making distilled liquors from grain is known as distillers' grains, or "slump." It is very watery. A cooked and dried distillery waste is sold under the name of grano gluten.

PREPARATION OF FOOD FOR ANIMALS.

One point upon which there seems to be much misconception is as to the influence of previous treatment of the food on its digestibility. Thus, for example, the effect of drying hay is not to lessen its digestibility, as is often believed. The soluble materials may be washed out if the hay is rained upon, and the tender parts may be lost in harvesting, but in ordinary haymaking the water of the grass is largely dried out without the digestibility of the constituents being materially affected.

Hay stored for a long time, even when kept dry and not allowed to heat, appears to lose a part of its value as food. Experiments have shown that rowen was less digestible after keeping over winter than when cut in the fall, even though there was no change in composition; and it was not as well relished by animals.

COOKING AND STEAMING FOOD.

There has been considerable misconception as to the value of cooking or steaming food for stock. Experiments abroad have indicated that cooking or steaming coarse or unpalatable food was advantageous, not on account of making the food more nutritious, but in inducing the animals to eat larger quantities of it. In fact it has been shown for lupine hay and some other materials that the digestibility of certain of the food ingredients, notably the albuminoids, was diminished by steaming; and the cooking of potatoes, which was formerly believed advantageous, has been shown to be of no advantage whatever in case of milch cows, although it was of some advantage to pigs. Julius Kühn, in his book on feeding, says:

> Unless large amounts of straw and coarse foods are to be fed and the supply of good hay and hoed crops is scarce it will usually be more profitable to omit the steaming. If the reverse condition prevails steaming will be found a very advantageous means of inducing the animals to eat sufficiently large quantities of the food.

Ladd, while connected with the New York State Station, reported analyses of cooked and uncooked clover hay and corn meal and determinations of the digestibility of the same. These showed that the percentage of albuminoids and fat and the relative digestibility of the albuminoids were more or less diminished by cooking. The experiments made by our experiment stations in preparing food have been mostly with pigs. At least thirteen separate series of experiments in different parts of this country have been reported on the value of cooking or steaming food for pigs. In these cooked or steamed barley meal, corn meal, and shorts; whole corn; whole corn and shorts; peas, corn and oat meal; potatoes, and a mixture of peas, barley, and rye have been compared with the same foods uncooked (and usually dry). In ten of these trials there has not only been no gain from cooking, but there has been a positive loss, i. e., the amount of food required to produce a pound of gain was larger when the food was cooked than when it was fed raw, and in some cases the difference has been considerable. In the three exceptional cases there was either no gain at all or only very slight gain from cooking or steaming, amounting to 2 per cent in one case.

Experiments in feeding steamed cotton seed to cows are reported by the Mississippi Station. The station concludes from three years' work that "the milk and butter from cows fed on steamed cotton seed cost less than that from cows fed on raw cotton seed and but little more than one-half as much as that from cows fed on cotton-seed meal. The butter from steamed cotton-seed is superior in quality to that from

either raw seed or cotton-seed meal." The Texas Station finds it advantageous to boil cotton seed for steers.

MOISTENING AND SOAKING FOOD.

Three stations have reported comparisons of dry with wet or soaked food for pigs. The food consisted of shelled corn in one case, of a mixture of corn meal and shorts in another, and of a mixture of corn meal, shorts, and linseed meal in a third. In every case the pigs ate more of the wet food and made larger gains on it. The additional gain was usually due to the larger amount of food eaten when moistened or soaked. The Kansas Station has just reported an experiment in soaking corn for steers. The shelled corn for one lot (5 steers) was soaked until it began to soften, and that for the other lot (5 steers) was fed dry. From November 7 to April 6 the lot on soaked corn ate 282 bushels of corn and gained 1,632 pounds, while the other lot ate 290 bushels of corn and gained only 1,468 pounds—a difference of 164 pounds. Owing to their better condition the steers fed soaked corn brought a higher price, giving a balance of $25.50 in favor of soaking. The conclusion is that it will pay to soak corn for steers if it can be done for 6 cents a bushel. Soaking wheat for pigs is quite generally recommended.

CUTTING COARSE FODDER.

The Maine Station compared the value of chopped and unchopped hay for cows, and found no evidence that the chopping had any effect. Cutting corn stover was found advantageous at the Wisconsin Station. The Indiana Station found that steers made better gains on cut than on uncut clover hay. In reference to cutting coarse fodder Professor Henry says:

> There should be a good feed cutter on every dairy farm, useful for silo filling in the fall and for chaffing feed in the winter. All cornstalks should be put through this machine, for then they are in better condition for feeding, and the coarser portions left uneaten are in good form for bedding and the manure heap. Long cornstalks are a nuisance in the feeding manger, worthless for bedding, and troublesome in the manure pile. Many farmers find difficulty in feeding cut cornstalks, since sometimes the cows refuse to eat them. In a few cases we have found that the sharp ends of the cornstalks, when cut certain lengths, injure the mouths of the cows. Where they are not well eaten the cause is often due to overfeeding, or endeavoring to have the cows live on too limited a variety of foods. Keep the mangers clean and feed the cut fodder with care, and usually very little will be left over, and that only the coarsest portion. Experiments at the Wisconsin Station show that with the varieties of corn raised there much more of the cut stalks will be eaten than if fed uncut under the same conditions.

FEEDING FOR FAT AND FOR LEAN.

The theory has been advanced that the relative production of fat and lean meat can be largely influenced by feeding. Experiments bearing on this question have been mainly with pigs, but two are reported with cattle. At the Missouri Agricultural College Professor Sanborn fed calves on a ration containing different proportions of protein (nitroge-

nous material). The nutritive ratio (ratio of protein to carbohydrates and fat) of the food of one lot was 1 to 2.4 (narrow) and of the other lot 1 to 5.5. Both lots gained practically the same amount in weight, but the character of the growth was quite different. There was nearly one-fourth more fat on the intestinal and vital organs of the lot on the wider ration (1 to 5.5) than in the case of the other lot. "The meat of lot 1 (ratio 1 to 2.4) was distinctly more fibrous in character and showed a denser fiber without the light streaking of fat."

The New York State Station compared rations with a wide nutritive ratio (carbonaceous) and a narrow ratio (nitrogenous), the difference in proportion of protein being brought about by substituting a part of the corn meal in the carbonaceous rations with cotton-seed meal, linseed meal, or gluten meal. "In general appearance the lot fed the nitrogenous ration was much the better, having a cleaner, brighter coat of hair. The photographs of the meat show little, if any, difference in the proportion of fat and lean." The meat of animals fed on the carbonaceous rations (corn meal largely) was thought to be "much the tenderer and sweeter."

Recent experiments in feeding steers at the Kansas Station have shown the value and the effect of a nitrogenous ration for this purpose as compared with one composed largely of corn. The meat from the lot fed the more nitrogenous ration brought a higher price.

Experiments by Professor Sanborn at the Missouri Agricultural College in 1884, 1885, and 1886 strongly indicated that the character of the food influenced the character of the pork produced, and that such nitrogenous foods as shorts, middlings, and dried blood, as compared with corn meal fed alone, tended to increase the proportion of lean pork to fat. The matter was taken up by Professor Henry, of Wisconsin, in 1886, and by several others later. His experiments all corroborate Professor Sanborn's work. Pigs fed shorts, bran, skim milk, or dried blood produced a larger proportion of lean pork than those fed corn alone.

In discussing his four years' experiment, Professor Henry says:

> We feel warranted in maintaining that the kind of food supplied to young growing pigs has a very marked effect upon the animal carcass; the foods rich in protein tend to build up strong muscular frames and large individuals, with ample blood and fully developed internal organs; that excessive corn feeding of pigs, even after they have obtained a good start, tends to dwarf the animal in size and prematurely fatten it; that, owing to the larger amount of ash contained, and perhaps for other causes, pigs receiving the usual nitrogenous foods have stronger bones than those fed on corn; and that the bones of pigs fed on corn contain the least mineral matter. * * * After the pigs have reached the age of seven or eight months there is far less necessity for nitrogenous foods, and the cheapest gains can be made with corn.

Taken in connection with the testimony of butchers and pork packers, that the demand for fat beef and fat pork is decreasing, these facts are of considerable importance to feeders.

WHEAT AS A FOOD FOR ANIMALS.

The low price of wheat which has recently prevailed has led to its use to a considerable extent as a food for growing and fattening animals. Until recently there has been little or no literature on wheat feeding, because the price of wheat has usually been such as to discourage its use as an animal food. But the experience of the last two years has furnished abundant evidence of the high value of wheat as a feed for all kinds of stock. Farmers in the West have fed it extensively and with almost universal satisfaction, financially and otherwise. It is estimated that up to November 1, 1894, upward of 46,000,000 bushels of wheat had been fed by the farmers of the United States. In Kansas alone over 4,059,000 bushels, or 16½ per cent of the total crop of 1893, were fed to farm animals. It has been fed satisfactorily to pigs from the weaning stage until they were fattened for the market; to colts, to work horses and trotters, to calves, to steers, to lambs and sheep, and to milch cows. It has proved itself to be the best single grain for stock, all things considered, and the cheapest at current prices. There is good reason for this for its composition shows it to be the richest of all the cereal grains. One hundred pounds of wheat furnishes more real nutriment than a similar amount of any other grain. The table on page 7 shows that 100 pounds of corn contains about 8 pounds of digestible protein, barley 8.69 pounds, oats 9.25 pounds, and rye 9.12 pounds, while 100 pounds of wheat contains 10.23 pounds of digestible protein. The amounts of digestible nutrients in a bushel of 56 pounds of corn and in one of 60 pounds of wheat are shown in the following table:

Nutrients in a bushel of corn and of wheat.

	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel, value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
56 pounds of corn	49.90	4.44	37.34	2.40	87,827
60 pounds of wheat	53.70	6.14	41.53	1.01	92,909

At equal prices the wheat is considerably the cheaper feed. When, as recently, 60 pounds of wheat sells for less than 56 pounds of corn the economy of wheat is apparent. Wheat is especially adapted to young growing animals which have muscle and bone to form, owing to its richness in protein. It also contains more ash than corn. Professor Henry places the value of wheat for growing animals at from a tenth to a quarter more than corn, and this is borne out by the above figures.

As to the effect of wheat on the health of animals, Dr. Salmon says:

> There are certain points to be borne in mind when one is commencing to feed wheat. Our domesticated animals are all very fond of it, but are not accustomed to eating it. Precautions should consequently be observed to prevent accidents and disease from its use. It is a matter of common observation that when full-fed horses are changed from old to new oats they are liable to attacks of indigestion, colic, and founder. If such results follow the change from old to new oats, how much more

likely are they to follow a radical change, such as that from oats to wheat? For this reason wheat should at first be fed in small quantities. It should, when possible, be mixed with some other grain, and care should be taken to prevent any one animal from getting more than the quantity intended for it.

These precautions are especially necessary when wheat is fed to horses, as these animals are peculiarly liable to colic and other disturbances of the digestive organs, accompanied or followed by laminitis. Cattle, sheep, and hogs frequently crowd each other from the feeding troughs, in which case some individuals obtain more than their share, and may bring on serious or fatal attacks of indigestion.

To guard against danger from indigestion and to utilize wheat to the best advantage it should be fed with other grains. The hard husk inclosing the oat kernel helps to lighten it up in the stomach and make it one of the safest grains for feeding. With wheat, on the other hand, more precaution is necessary. For horses, cattle, and pigs wheat should be coarsely ground or soaked for twelve to sixteen hours, perhaps more, or boiled; for sheep it may be fed whole. An English authority on feeding has found whole wheat the cheapest feed for sheep. He estimates wheat fed to lambs about ten months old as worth about 76 cents per bushel. The Indiana Station realized 77 cents per bushel for wheat fed to sheep.

A Western farmer who has fed about 2,000 bushels of wheat the past two years, and is still continuing its use, reports that he never feeds wheat alone, but mixes equal parts (by bulk) of coarsely ground wheat and bran, or of wheat, bran, and oats. These mixtures he feeds to horses, milch cows, lambs, calves, and pigs with perfect success. They are fed dry to all except the pigs, for which they are soaked for forty-eight hours.

For young pigs wheat may be fed with a little corn with good results, increasing the proportion of corn as the pigs grow, the corn predominating during the final fattening period. One farmer reports feeding young pigs still with the sow on soaked wheat during weaning with excellent gains. It would be difficult to find a better food for young pigs and shoats than 2 parts (by weight) of wheat, 2 parts of corn, and 1 of shorts, or equal parts of wheat, corn, and shorts. These mixtures will prove more satisfactory than wheat alone, although hogs on clover pasture have been fed whole wheat dry without injury and made a gain of 14 pounds per bushel of wheat. In feeding whole wheat either dry or soaked to pigs there is danger that considerable will pass through the animal undigested. Where pigs are allowed to bolt the food the wheat is not sufficiently chewed. The ground wheat may be mixed with corn and shorts and made into a slop. Some have taken the trouble to grind and then soak the wheat for hogs, and are of opinion that it pays. With hogs at 4½ cents, wheat fed in this way brought 68½ cents per bushel. The amount of pork made per bushel of wheat varies all the way from 10 to 20 pounds. From 12 to 15 pounds is probably all that should be expected, and with pork at 5 cents the wheat will be disposed of to better advantage than selling at 50 cents

a bushel. Farmers report getting all the way from 55 to 70 cents per bushel for wheat fed to pigs.

In experiments at the Oregon Experiment Station 13½ pounds of pork was made for each bushel of wheat. A mixture of equal weights of chopped wheat and oats gave a pound of pork for 4.8 pounds of food. At the South Dakota Station spring wheat of rather poor quality fed alone to pigs brought 55.8 cents per bushel when fed whole, and 58.4 cents when fed ground. On ground wheat 4.81 pounds and on whole wheat 4.91 pounds of wheat were eaten per pound of gain. The pork made on ground wheat was about the same quality as that made on corn and superior to that made on either whole wheat, field peas, or mixed food. The pigs had access to salt and hard-wood ashes at all times. The Wisconsin Station has fed wheat, corn, and a mixture of the two, ground, to hogs with good results, the mixture of corn and meal and ground wheat showing the best gains for the food eaten.

In Canada Professor Robertson found that frozen wheat fed to pigs, between 61 and 145 pounds in weight, gave an average increase of 15.46 pounds per bushel. With heavier fattening hogs, from 9 to 11 pounds of gain was made per bushel of wheat. With pigs bringing 5 cents per pound, 73 cents per bushel was realized for the frozen wheat in the first case, and 43 cents in the last. He recommends that when wheat is fed unground it be soaked for twenty-four hours.

If care is exercised steers can be fed almost exclusively on wheat. In that case it should be rolled or crushed and fed with a little bran or on moistened cut hay. But here, as elsewhere, it is more advisable to feed wheat with some other grain. Fed ground and mixed with corn it has given good results. The experimental farm at Manitoba reports a trial of feeding frozen wheat to 2-year-old steers. The wheat was cracked and fed with wheat straw or straw and turnips. The wheat was No. 3 quality, but it gave a return of 56 cents per bushel with beef at 4 cents.

For horses wheat should be coarsely ground and fed on moistened hay, alone or with bran.

For cows it is recommended to crush or coarsely grind wheat and feed it mixed with bran. A ration often recommended is 6 to 8 pounds of bran and 6 pounds of wheat. Such a ration, with coarse fodders, would give:

Ration per cow daily.

	Dry matter.	Digestible protein.	Fuel value.
	Pounds.	*Pounds.*	*Calories.*
10 pounds rowen hay (second cut)	8.34	0.72	9,604
20 pounds silage	4.18	0.11	5,943
6 pounds bran	5.31	0.72	6,668
6 pounds wheat	5.37	0.62	9,291
Total	23.20	2.17	31,506
Standard ration	24.00	2.50	29,588

The substitution of 1 pound of linseed meal for 1 pound of the wheat would bring this ration nearer the standard. Farmers have reported good results with a mixture of equal parts of bran and wheat. It gave good results at the Ontario Agricultural College, and better than wheat alone. If the coarse fodders mentioned above are not at hand, the ration may be varied by feeding 5 pounds of mixed hay, 10 pounds of dry corn fodder, the amounts of bran and wheat mentioned above, and 2 pounds of cotton-seed meal or 3 pounds of gluten meal.

Low-grade wheat flour is often a cheaper cattle food than wheat. This flour contains the germ of the wheat, which makes it turn dark colored, but also enriches it considerably. It should be used in much the same way as ground or crushed wheat.

With the present low price of wheat the farmer is advised to keep for feeding all wheat which will not bring the price of first-class grain, and sell only the first-quality wheat. If possible the wheat should be graded rather than sold at an inferior price.

APPENDIX.

In the following tables the composition of a large number of feeding stuffs in common use is given from American sources, previous tables being revised for this purpose. Not only are the averages given but also the highest and lowest result found for each ingredient in the various materials. That is, in the case of the minimum and maximum, the figures given do not represent the results of single analyses, but are the highest and lowest results which have been found in the case of each ingredient. They are given to show the limits within which each ingredient has been found to vary.

Composition of feeding stuffs.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER.							
Corn fodder:[1]							
Flint varieties—	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	51.5	0.7	0.6	2.1	4.3	0.3	......
Maximum	90.8	1.8	4.0	11.4	36.3	1.3	......
Average	**79.8**	**1.1**	**2.0**	**4.3**	**12.1**	**0.7**	**40**
Flint varieties cut after kernels had glazed—							
Minimum	69.7	0.9	1.5	3.0	10.0	0.6	......
Maximum	83.7	1.7	2.7	6.1	19.7	1.3	......
Average	**77.1**	**1.1**	**2.1**	**4.3**	**14.6**	**0.8**	**10**
Dent varieties—							
Minimum	59.5	0.6	0.5	2.0	3.0	0.1	......
Maximum	93.6	2.5	3.8	11.0	27.0	1.6	......
Average	**79.0**	**1.2**	**1.7**	**5.6**	**12.0**	**0.5**	**68**
Dent varieties cut after kernels had glazed—							
Minimum	59.5	1.0	1.0	5.4	11.6	0.4	......
Maximum	80.7	2.2	3.3	8.5	27.0	1.6	......
Average	**73.4**	**1.5**	**2.0**	**6.7**	**15.5**	**0.9**	**7**
Sweet varieties—							
Minimum	69.3	0.8	0.9	1.9	3.2	0.1	......
Maximum	92.9	2.6	2.7	8.5	19.4	1.0	......
Average	**79.1**	**1.3**	**1.9**	**4.4**	**12.8**	**0.5**	**21**

[1] Corn fodder is the entire plant, usually a thickly planted crop. Corn stover is what is left after the ears are harvested.

Composition of feeding stuffs—**Continued.**

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER—continued.							
Corn fodder—Continued.							
All varieties—	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	51.5	0.6	0.5	1.9	3.0	0.1	......
Maximum	93.6	2.6	4.0	11.4	36.3	1.6	......
Average	**79.3**	**1.2**	**1.8**	**5.0**	**12.2**	**0.5**	**126**
Leaves and husks, cut green—							
Minimum	57.9	2.1	1.8	6.6	16.7	1.0	......
Maximum	71.3	4.4	2.4	12.5	22.2	1.3	......
Average	**66.2**	**2.9**	**2.1**	**8.7**	**19.0**	**1.1**	**4**
Stripped stalks, cut green—							
Minimum	74.5	0.6	0.4	6.7	14.2	0.4	......
Maximum	77.4	0.8	0.6	8.8	16.0	0.6	......
Average	**76.1**	**0.7**	**0.5**	**7.8**	**14.9**	**0.5**	**4**
Rye fodder:							
Minimum	74.4	1.3	2.3	4.7	4.9	0.2	......
Maximum	84.3	2.4	3.0	14.9	12.4	0.7	......
Average	**76.6**	**1.8**	**2.6**	**11.6**	**6.8**	**0.6**	**7**
Oat fodder:							
Minimum	31.3	1.5	1.5	7.1	10.8	0.4	......
Maximum	78.6	4.2	6.1	16.8	39.8	3.0	......
Average	**62.2**	**2.5**	**3.4**	**11.2**	**19.3**	**1.4**	**6**
Redtop,[1] in bloom:							
Minimum	51.5	1.7	2.0	8.0	11.7	0.6	......
Maximum	76.2	2.9	4.3	15.7	21.9	1.1	......
Average	**65.3**	**2.3**	**2.8**	**11.0**	**17.7**	**0.9**	**5**
Tall oat grass,[2] **in bloom:**							
Minimum	62.3	1.6	1.7	9.2	13.0	0.6	......
Maximum	73.5	3.0	3.3	9.7	20.7	1.5	......
Average	**69.5**	**2.0**	**2.4**	**9.4**	**15.8**	**0.9**	**3**
Orchard grass, in bloom:							
Minimum	66.9	1.6	1.9	5.8	9.9	0.7	......
Maximum	77.3	2.9	4.1	11.1	16.6	1.3	......
Average	**73.0**	**2.0**	**2.6**	**8.2**	**13.3**	**0.9**	**4**
Meadow fescue, in bloom:							
Minimum	67.6	1.6	1.8	10.2	12.5	0.7	......
Maximum	73.2	2.0	2.7	11.3	15.7	1.1	......
Average	**69.9**	**1.8**	**2.4**	**10.8**	**14.3**	**0.8**	**4**
Italian rye grass, coming into bloom:							
Minimum	69.6	2.1	2.6	5.5	11.5	1.1	......
Maximum	76.6	2.8	3.8	7.5	15.4	1.6	......
Average	**73.2**	**2.5**	**3.1**	**6.8**	**13.3**	**1.3**	**24**
Timothy,[3] at different stages:							
Minimum	47.0	1.4	1.3	5.1	10.1	0.6	......
Maximum	78.7	3.2	3.8	19.4	28.6	2.0	......
Average	**61.6**	**2.1**	**3.1**	**11.8**	**20.2**	**1.2**	**56**
Kentucky blue grass,[4] at different stages:							
Minimum	51.7	1.6	2.4	3.8	6.5	0.8	......
Maximum	82.5	4.8	7.2	14.8	26.6	1.9	......
Average	**65.1**	**2.8**	**4.1**	**9.1**	**17.6**	**1.3**	**18**
Hungarian grass:							
Minimum	62.7	1.9	2.8	7.6	9.1	0.5	......
Maximum	78.3	2.2	3.2	10.8	20.1	1.1	......
Average	**71.1**	**1.7**	**3.1**	**9.2**	**14.2**	**0.7**	**14**
Red clover, at different stages:							
Minimum	47.1	0.9	1.7	1.8	3.5	0.3	......
Maximum	91.8	4.0	7.1	14.7	25.8	1.8	......
Average	**70.8**	**2.1**	**4.4**	**8.1**	**13.5**	**1.1**	**43**
Alsike clover,[5] in bloom:							
Minimum	72.3	1.9	3.6	5.3	10.8	0.6	......
Maximum	77.3	2.1	4.2	9.4	11.5	1.2	......
Average	**74.8**	**2.0**	**3.9**	**7.4**	**11.0**	**0.9**	**4**
Crimson clover:							
Minimum	78.4	1.4	2.7	3.5	7.0	0.6	......
Maximum	84.6	2.0	3.5	6.3	9.7	0.8	......
Average	**80.9**	**1.7**	**3.1**	**5.2**	**8.4**	**0.7**	**3**
Alfalfa,[6] at different stages:							
Minimum	49.3	1.8	3.5	2.5	10.8	0.6	......
Maximum	82.0	5.1	7.7	14.8	11.5	1.2	......
Average	**71.8**	**2.7**	**4.8**	**7.4**	**12.3**	**1.0**	**23**
Serradella, at different stages:							
Minimum	65.6	1.8	2.1	2.0	8.9	0.4	......
Maximum	84.6	5.8	3.6	7.8	17.1	1.8	......
Average	**79.5**	**3.2**	**2.7**	**5.4**	**8.6**	**0.7**	**9**
Cowpea:							
Minimum	72.8	1.2	1.5	1.7	1.8	0.2	......
Maximum	93.1	2.7	3.5	15.3	12.9	0.6	......
Average	**83.6**	**1.7**	**2.4**	**4.8**	**7.1**	**0.4**	**10**

[1] Herd's grass of Pennsylvania.
[2] Meadow oat grass.
[3] **Herd's grass of New England and New York.**
[4] June grass.
[5] Swedish clover.
[6] **Lucern.**

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GREEN FODDER—continued.							
Soja bean:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	63.6	1.8	2.2	4.8	5.8	0.5	....
Maximum	81.5	5.1	5.9	9.7	16.0	1.6	....
Average	**75.1**	**2.6**	**4.0**	**6.7**	**10.6**	**1.0**	**27**
Horse bean:							
Average	**84.2**	**1.2**	**2.8**	**4.9**	**6.5**	**0.4**	**2**
Flat pea (*Lathyrus sylvestris*):							
Average	**66.7**	**2.9**	**8.7**	**7.9**	**12.2**	**1.6**	**2**
Rape:							
Average	**84.5**	**2.0**	**2.3**	**2.6**	**8.4**	**0.5**	**2**
SILAGE.							
Corn silage:							
Minimum	62.4	0.3	0.7	3.0	5.1	0.2	....
Maximum	87.7	3.3	3.6	10.5	24.2	2.0	....
Average	**79.1**	**1.4**	**1.7**	**6.0**	**11.0**	**0.8**	**99**
Sorghum silage:							
Minimum	71.9	0.8	0.6	5.9	13.8	0.1	....
Maximum	78.0	1.2	0.9	6.8	19.0	0.5	....
Average	**76.1**	**1.1**	**0.8**	**6.4**	**15.3**	**0.3**	**6**
Red clover silage:							
Minimum	61.4	1.9	3.0	5.1	8.1	0.9	....
Maximum	78.6	3.0	5.9	13.9	14.3	1.6	....
Average	**72.0**	**2.6**	**4.2**	**8.4**	**11.6**	**1.2**	**5**
Soja bean silage:							
Average	**74.2**	**2.8**	**4.1**	**9.7**	**6.9**	**2.2**	**1**
Cowpea vine silage:							
Average	**79.3**	**2.9**	**2.7**	**6.0**	**7.6**	**1.5**	**2**
Field pea vine silage:							
Average	**50.1**	**3.5**	**5.9**	**13.0**	**26.0**	**1.6**	**1**
Silage of mixture of cowpea vines and soja bean vines, average	**69.8**	**4.5**	**3.8**	**9.5**	**11.1**	**1.3**	**1**
HAY AND DRY COARSE FODDER.							
Corn fodder,[1] field cured:							
Minimum	22.9	1.5	2.7	7.5	20.6	0.6	....
Maximum	60.2	5.5	6.9	24.7	47.8	2.5	....
Average	**42.2**	**2.7**	**4.5**	**14.3**	**34.7**	**1.6**	**35**
Corn leaves, field cured:							
Minimum	14.8	4.3	4.5	17.4	27.3	0.8	....
Maximum	44.0	7.4	8.3	27.4	41.4	2.2	....
Average	**30.0**	**5.5**	**6.0**	**21.4**	**35.7**	**1.4**	**17**
Corn husks, field cured:							
Minimum	26.7	0.6	1.3	6.8	14.3	0.5	....
Maximum	76.6	2.3	3.2	23.6	43.6	1.0	....
Average	**50.9**	**1.8**	**2.5**	**15.8**	**28.3**	**0.7**	**16**
Corn stalks, field cured:							
Minimum	51.3	0.6	1.2	6.9	11.2	0.3	....
Maximum	78.5	2.0	3.0	16.8	26.0	1.0	....
Average	**68.4**	**1.2**	**1.9**	**11.0**	**17.0**	**0.5**	**15**
Corn stover,[2] field cured:							
Minimum	15.4	1.7	1.8	14.1	23.3	0.7	....
Maximum	57.4	7.0	8.3	32.2	53.3	2.2	....
Average	**40.5**	**3.4**	**3.8**	**19.7**	**31.5**	**1.1**	**60**
Hay from:							
Redtop,[3] cut at different stages—							
Minimum	6.8	3.8	5.9	24.0	44.8	1.4	....
Maximum	11.6	7.0	10.4	31.8	50.4	3.2	....
Average	**8.9**	**5.2**	**7.9**	**28.6**	**47.5**	**1.9**	**9**
Redtop, cut in bloom—							
Minimum	6.8	4.8	7.8	24.0	46.8	1.5	....
Maximum	11.6	6.5	10.4	31.8	47.8	2.3	....
Average	**8.7**	**4.9**	**8.0**	**29.9**	**46.4**	**2.1**	**3**
Orchard grass—							
Minimum	6.5	5.0	6.6	28.9	32.9	1.7	....
Maximum	13.6	7.9	10.4	38.3	48.6	3.3	....
Average	**9.9**	**6.0**	**8.1**	**32.4**	**41.0**	**2.6**	**10**
Timothy,[4] all analyses—							
Minimum	6.1	2.5	3.8	22.2	34.3	1.0	....
Maximum	28.9	6.3	9.8	38.5	58.5	4.0	....
Average	**13.2**	**4.4**	**5.9**	**29.0**	**45.0**	**2.5**	**68**
Timothy, cut in full bloom—							
Minimum	7.0	2.5	5.0	22.2	34.4	2.0	....
Maximum	28.9	6.6	7.5	37.1	48.5	4.0	....
Average	**15.0**	**4.5**	**6.0**	**29.6**	**41.9**	**3.0**	**12**

[1] Entire plant.
[2] What is left after the ears are harvested.
[3] Herd's grass of Pennsylvania.
[4] Herd's grass of New England and New York.

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
HAY AND DRY COARSE FODDER—continued.							
Hay from:							
Timothy cut soon after bloom—	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	7.8	3.5	4.6	25.7	37.0	1.7	......
Maximum	21.6	5.4	8.1	33.4	51.0	3.6	......
Average	**14.2**	**4.4**	**5.7**	**28.1**	**44.6**	**3.0**	**11**
Timothy cut when nearly ripe—							
Minimum	7.0	2.7	4.3	24.8	38.0	1.0	......
Maximum	22.7	5.1	6.0	38.5	49.1	2.8	......
Average	**14.1**	**3.9**	**5.0**	**31.1**	**43.7**	**2.2**	**12**
Kentucky blue grass—							
Minimum	14.3	4.5	5.3	17.7	31.8	2.0	......
Maximum	32.8	7.8	12.9	26.8	51.1	4.2	......
Average	**21.2**	**6.3**	**7.8**	**23.0**	**37.8**	**3.9**	**10**
Cut when seed was in milk—							
Minimum	22.5	5.6	6.0	23.9	33.2	3.4	......
Maximum	26.5	7.6	6.6	24.9	35.4	4.1	......
Average	**24.4**	**7.0**	**6.3**	**24.5**	**34.2**	**3.6**	**4**
Cut when seed was ripe—							
Minimum	23.7	5.1	5.3	20.4	33.6	2.8	......
Maximum	32.8	7.8	6.0	25.7	33.7	3.2	......
Average	**27.8**	**6.4**	**5.8**	**23.8**	**33.2**	**3.0**	**4**
Hungarian grass—							
Minimum	4.9	5.0	4.7	23.6	44.4	1.5	......
Maximum	9.5	7.5	12.3	36.3	53.0	3.5	......
Average	**7.7**	**6.0**	**7.5**	**27.7**	**49.0**	**2.1**	**13**
Meadow fescue—							
Minimum	7.4	5.5	4.5	20.8	28.5	1.6	......
Maximum	32.5	7.8	11.8	31.9	45.5	3.5	......
Average	**20.0**	**6.8**	**7.0**	**25.9**	**38.4**	**2.7**	**9**
Italian rye grass—							
Minimum	7.4	6.1	5.7	28.4	39.6	1.3	......
Maximum	9.3	7.9	8.8	33.9	48.9	1.9	......
Average	**8.5**	**6.9**	**7.5**	**30.5**	**45.0**	**1.7**	**4**
Mixed grasses—							
Minimum	6.5	2.1	4.8	21.0	33.4	1.3	......
Maximum	33.4	6.9	12.1	38.4	50.8	4.9	......
Average	**15.3**	**5.5**	**7.4**	**27.2**	**42.1**	**2.5**	**126**
Rowen (mixed)[1]—							
Minimum	8.2	5.1	9.6	20.1	33.6	2.2	......
Maximum	24.4	7.2	14.8	20.0	44.3	4.5	......
Average	**16.6**	**6.8**	**11.6**	**22.5**	**39.4**	**3.1**	**23**
Mixed grasses and clovers—							
Minimum	8.2	3.9	5.5	19.7	31.8	1.5	......
Maximum	15.9	9.6	14.4	35.1	48.9	3.1	......
Average	**12.9**	**5.5**	**10.1**	**27.6**	**41.3**	**2.6**	**17**
Swamp hay—							
Minimum	7.8	3.3	5.0	19.4	39.9	0.8	......
Maximum	17.9	12.1	8.8	31.6	51.7	3.6	......
Average	**11.6**	**6.7**	**7.2**	**26.6**	**45.9**	**2.0**	**8**
Salt marsh—							
Minimum	7.8	5.4	4.0	25.1	34.1	1.6	......
Maximum	18.6	11.8	7.8	33.8	54.3	3.1	......
Average	**10.4**	**7.7**	**5.5**	**30.0**	**44.1**	**2.4**	**10**
Red clover—							
Minimum	6.0	3.9	10.0	15.6	27.3	1.5	......
Maximum	31.3	8.3	20.2	35.7	52.2	5.9	......
Average	**15.3**	**6.2**	**12.3**	**24.8**	**38.1**	**3.3**	**38**
Red clover in bloom—							
Minimum	6.0	5.6	10.8	17.9	27.3	2.5	......
Maximum	31.3	8.3	15.4	28.1	41.3	5.9	......
Average	**20.8**	**6.6**	**12.4**	**21.9**	**33.8**	**4.5**	**6**
Alsike clover—							
Minimum	5.3	6.1	9.2	19.7	35.6	1.6	......
Maximum	13.9	12.2	16.1	29.5	45.9	4.2	......
Average	**9.7**	**8.3**	**12.8**	**25.6**	**40.7**	**2.9**	**9**
White clover—							
Minimum	6.1	4.5	13.9	20.3	33.4	1.7	......
Maximum	13.5	13.8	20.0	30.3	47.3	5.8	......
Average	**9.7**	**8.3**	**15.7**	**24.1**	**39.3**	**2.9**	**7**
Crimson clover—							
Minimum	5.9	7.4	13.6	20.1	29.3	1.5	......
Maximum	13.4	13.0	16.1	34.9	42.6	4.8	......
Average	**9.6**	**8.6**	**15.2**	**27.2**	**36.6**	**2.8**	**7**
Japan clover—							
Average	**11.0**	**8.5**	**13.8**	**24.0**	**39.0**	**3.7**	**2**
Vetch—							
Minimum	8.3	7.1	13.1	19.7	26.5	1.6	......
Maximum	15.8	11.6	23.1	28.1	40.2	3.0	......
Average	**11.3**	**7.9**	**17.0**	**25.4**	**36.1**	**2.3**	**5**

[1] Second cut.

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
HAY AND DRY COARSE FODDER—continued.							
Hay from:							
Serradella—	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	7.2	5.4	13.9	19.4	40.5	2.2	......
Maximum	11.7	10.8	16.6	22.9	46.0	2.9	......
Average	**9.2**	**7.2**	**15.2**	**21.6**	**44.2**	**2.6**	**8**
Alfalfa[1]—							
Minimum	4.6	3.1	10.2	14.0	35.1	1.1	......
Maximum	16.0	10.4	20.3	33.0	53.6	3.8	......
Average	**8.4**	**7.4**	**14.3**	**25.0**	**42.7**	**2.2**	**21**
Cowpea—							
Minimum	7.6	3.2	13.6	16.4	39.4	1.1	......
Maximum	14.0	10.2	20.3	26.0	49.5	3.7	......
Average	**10.7**	**7.5**	**16.6**	**20.1**	**42.2**	**2.2**	**8**
Soja bean—							
Minimum	6.1	4.8	14.0	17.3	31.8	2.4	......
Maximum	20.1	8.9	18.1	32.3	41.0	7.5	......
Average	**11.3**	**7.2**	**15.4**	**22.3**	**38.6**	**5.2**	6
Flat pea (*Lathyrus sylvestris*)—							
Minimum	6.3	6.5	17.6	18.5	27.7	1.6	......
Maximum	10.0	8.6	27.9	32.7	34.0	4.6	......
Average	**8.4**	**7.9**	**22.9**	**26.2**	**31.4**	**3.2**	5
Peanut vines (without nuts)—							
Minimum	6.3	7.3	9.1	18.3	33.1	1.7	......
Maximum	7.8	15.7	11.7	33.3	50.4	5.8	......
Average	**7.6**	**10.8**	**10.7**	**28.6**	**42.7**	**4.6**	6
Soja-bean straw:							
Minimum	5.7	3.9	4.0	34.0	35.3	0.8	......
Maximum	14.0	4.9	4.9	49.6	43.3	3.2	......
Average	**10.1**	**5.8**	**4.6**	**40.4**	**37.4**	**1.7**	**4**
Horse-bean straw:							
Average	**9.2**	**8.7**	**8.8**	**37.6**	**34.6**	**1.4**	**1**
Wheat straw:							
Minimum	6.5	3.0	2.9	34.3	31.0	0.8	......
Maximum	17.9	7.0	5.0	42.7	50.6	1.8	......
Average	**9.6**	**4.2**	**3.4**	**38.1**	**43.4**	**1.3**	**7**
Rye straw:							
Minimum	6.3	2.8	2.2	32.7	41.0	1.0	......
Maximum	9.7	3.4	3.6	43.3	52.9	1.6	......
Average	**7.1**	**3.2**	**3.0**	**38.9**	**46.6**	**1.2**	**7**
Oat straw:							
Minimum	6.5	3.7	2.7	31.8	33.5	1.7	......
Maximum	11.4	6.7	6.9	45.1	46.6	3.2	......
Average	**9.2**	**5.1**	**4.0**	**37.0**	**42.4**	**2.3**	**12**
Buckwheat straw:							
Minimum	9.0	4.0	3.3	37.2	32.1	0.7	......
Maximum	10.4	6.5	7.8	46.8	38.9	1.7	......
Average	**9.9**	**5.5**	**5.2**	**43.0**	**35.1**	**1.3**	**8**
ROOTS AND TUBERS.							
Potatoes:							
Minimum	75.4	0.8	1.1	0.3	14.1	......	......
Maximum	82.2	1.2	3.0	0.9	20.4	0.1	......
Average	**78.9**	**1.0**	**2.1**	**0.6**	**17.3**	**0.1**	**12**
Sweet potatoes:							
Minimum	66.0	0.7	0.5	0.6	18.0	0.3	......
Maximum	74.4	1.3	3.6	2.5	29.7	0.6	......
Average	**71.1**	**1.0**	**1.5**	**1.3**	**24.7**	**0.4**	**6**
Red beets:							
Minimum	85.8	0.7	1.1	0.6	3.8	0.1	......
Maximum	92.2	1.6	1.8	1.7	11.3	0.3	......
Average	**88.5**	**1.0**	**1.5**	**0.9**	**8.0**	**0.1**	**9**
Sugar beets:							
Minimum	80.5	0.4	1.1	0.6	5.7	0.1	......
Maximum	90.8	1.2	3.2	1.3	13.6	0.2	......
Average	**86.5**	**0.9**	**1.8**	**0.9**	**9.8**	**0.1**	**10**
Mangel-wurzels:							
Minimum	86.9	0.8	1.0	0.6	2.4	0.1	......
Maximum	94.4	1.4	1.9	1.3	8.7	0.5	......
Average	**90.9**	**1.1**	**1.4**	**0.9**	**5.5**	**0.2**	**9**
Turnips:							
Minimum	87.2	0.7	0.8	0.8	4.2	0.1	......
Maximum	92.4	1.0	1.4	1.4	8.8	0.2	......
Average	**90.5**	**0.8**	**1.1**	**1.2**	**6.2**	**0.2**	**3**
Ruta-bagas:							
Minimum	87.1	1.0	1.0	1.1	5.1	0.1	......
Maximum	91.8	1.4	1.3	1.4	9.1	0.3	......
Average	**88.6**	**1.2**	**1.2**	**1.3**	**7.5**	**0.2**	**4**

[1] Lucern.

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
ROOTS AND TUBERS—continued.							
Carrots:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	86.5	1.6	0.8	0.9	5.1	0.2	......
Maximum	91.1	1.3	2.0	2.3	10.4	0.7	......
Average	**88.6**	**1.0**	**1.1**	**1.3**	**7.6**	**0.4**	**8**
Artichokes:							
Average	**79.5**	**1.0**	**2.6**	**0.8**	**15.9**	**0.2**	**2**
GRAINS AND OTHER SEEDS.							
Corn kernel:							
Dent, all analyses—							
Minimum	6.2	1.0	7.5	0.9	65.9	3.1	......
Maximum	19.4	2.6	11.8	4.8	75.7	7.5	......
Average	**10.6**	**1.5**	**10.3**	**2.2**	**70.4**	**5.0**	**86**
Flint, all analyses—							
Minimum	4.5	1.0	7.0	0.7	65.0	3.4	......
Maximum	19.6	1.9	13.7	2.9	76.7	7.1	......
Average	**11.3**	**1.4**	**10.5**	**1.7**	**70.1**	**5.0**	**68**
Sweet, all analyses—							
Minimum	6.0	1.4	9.5	1.5	61.8	3.8	......
Maximum	10.9	2.4	15.3	5.2	72.4	9.3	......
Average	**8.8**	**1.9**	**11.6**	**2.8**	**66.8**	**8.1**	**26**
Pop varieties—							
Minimum	8.6	1.2	9.7	1.2	68.4	4.2	......
Maximum	11.8	1.7	13.1	2.3	71.1	6.0	......
Average	**10.7**	**1.5**	**11.2**	**1.8**	**69.6**	**5.2**	**4**
Soft varieties—							
Minimum	6.1	1.4	8.8	1.3	66.0	5.0	......
Maximum	14.1	1.9	14.6	3.3	75.5	5.7	......
Average	**9.3**	**1.6**	**11.4**	**2.0**	**70.2**	**5.5**	**5**
All varieties and analyses—							
Minimum	4.5	1.0	7.0	0.7	61.8	3.1	......
Maximum	20.7	2.6	15.3	5.2	76.7	9.3	......
Average	**10.9**	**1.5**	**10.5**	**2.1**	**69.6**	**5.4**	**208**
Sorghum seed:							
Minimum	9.3	1.4	7.7	1.5	59.0	2.1	......
Maximum	16.8	4.3	11.3	3.7	73.6	4.6	......
Average	**12.8**	**2.1**	**9.1**	**2.6**	**69.8**	**3.6**	**10**
Barley:							
Minimum	7.2	1.8	8.6	1.3	66.7	1.5	......
Maximum	12.6	3.2	15.7	4.2	73.9	3.2	......
Average	**10.9**	**2.4**	**12.4**	**2.7**	**69.8**	**1.8**	**10**
Oats:							
Minimum	8.9	2.0	8.0	1.5	53.5	3.4	......
Maximum	13.5	4.0	14.4	12.9	66.9	5.8	......
Average	**11.0**	**3.0**	**11.8**	**9.5**	**59.7**	**5.0**	**30**
Rye:							
Minimum	8.7	1.8	9.5	1.4	71.2	1.4	......
Maximum	13.2	1.9	12.1	2.1	73.9	2.1	......
Average	**11.6**	**1.9**	**10.6**	**1.7**	**72.5**	**1.7**	**6**
Wheat, spring varieties:							
Minimum	8.1	1.5	8.4	1.3	66.1	1.8	......
Maximum	13.4	2.6	15.4	2.3	74.9	2.6	......
Average	**10.4**	**1.9**	**12.5**	**1.8**	**71.2**	**2.2**	**13**
Wheat, winter varieties, all analyses:							
Minimum	7.1	0.8	8.1	0.4	66.7	1.3	......
Maximum	14.0	3.6	16.6	2.9	77.7	3.9	......
Average	**10.5**	**1.8**	**11.8**	**1.8**	**72.0**	**2.1**	**262**
Wheat, all varieties:							
Minimum	7.1	0.8	8.1	0.4	64.8	1.3	......
Maximum	14.0	3.6	17.2	3.1	77.7	3.9	......
Average	**10.5**	**1.8**	**11.9**	**1.8**	**71.9**	**2.1**	**310**
Rice:							
Minimum	11.4	0.3	5.9	0.1	77.5	0.3	......
Maximum	14.0	0.5	8.6	0.4	80.6	0.6	......
Average	**12.4**	**0.4**	**7.4**	**0.2**	**79.2**	**0.4**	**10**
Buckwheat:							
Minimum	10.9	1.6	8.6	7.8	62.6	2.2	......
Maximum	14.8	2.3	11.0	9.4	65.4	2.4	......
Average	**12.6**	**2.0**	**10.0**	**8.7**	**64.5**	**2.2**	**8**
Sunflower seed (whole):							
Minimum	8.5	2.1	15.8	29.5	22.0	20.9	......
Maximum	8.8	3.2	16.7	30.3	20.7	21.5	......
Average	**8.6**	**2.6**	**16.3**	**29.9**	**21.4**	**21.2**	**2**
Cotton seed, whole (with hulls):							
Minimum	7.0	2.9	14.5	20.3	17.3	18.9	......
Maximum	17.5	4.5	21.7	28.7	29.1	21.6	......
Average	**10.3**	**3.5**	**18.4**	**23.2**	**24.7**	**19.9**	**5**

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
GRAINS AND OTHER SEEDS—continued.							
Cotton-seed kernels (without hulls):	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	6.0	4.0	29.3	3.1	15.8	36.5	......
Maximum	6.3	5.4	33.1	4.4	19.5	36.6	......
Average	**6.2**	**4.7**	**31.2**	**3.7**	**17.6**	**36.6**	**2**
Cotton seed, whole, roasted:							
Minimum	2.9	2.3	16.1	16.8	21.1	22.5	......
Maximum	9.3	8.7	17.6	24.0	25.8	32.7	......
Average	**6.1**	**5.5**	**16.8**	**20.4**	**23.5**	**27.7**	**2**
Peanut kernel (without hulls):							
Minimum	4.9	1.9	23.2	2.0	12.7	35.0	......
Maximum	13.2	3.8	31.5	18.4	19.1	47.4	......
Average	**7.5**	**2.4**	**27.9**	**7.0**	**15.6**	**39.6**	**7**
Horse bean	11.3	3.8	26.6	7.2	50.1	1.0	1
Soja bean:							
Minimum	5.9	3.1	26.3	3.4	26.2	12.3	......
Maximum	19.3	5.4	40.2	6.1	32.8	19.0	......
Average	**10.8**	**4.7**	**34.0**	**4.8**	**28.8**	**16.9**	**8**
Cowpea:							
Minimum	10.0	2.9	19.3	2.5	50.5	1.3	......
Maximum	20.9	3.4	23.0	5.0	62.0	1.6	......
Average	**14.8**	**3.2**	**20.8**	**4.1**	**55.7**	**1.4**	**5**
MILL PRODUCTS.							
Corn meal:							
Minimum	8.0	0.9	7.1	0.5	60.4	2.0	......
Maximum	27.4	4.1	13.9	3.1	74.0	5.1	......
Average	**15.0**	**1.4**	**9.2**	**1.9**	**68.7**	**3.8**	**77**
Corn and cob meal:							
Minimum	9.5	1.2	5.8	4.7	56.8	2.5	......
Maximum	26.3	1.9	12.2	9.4	69.7	4.7	......
Average	**15.1**	**1.5**	**8.5**	**6.6**	**64.8**	**3.5**	**7**
Oatmeal:							
Minimum	6.2	1.8	12.9	0.6	66.6	6.1	......
Maximum	8.8	2.2	16.3	1.2	69.0	8.8	......
Average	**7.9**	**2.0**	**14.7**	**0.9**	**67.4**	**7.1**	**6**
Barley meal:							
Minimum	9.9	1.6	9.8	5.9	63.5	1.5	......
Maximum	13.6	3.8	12.7	7.0	68.0	3.2	......
Average	**11.9**	**2.6**	**10.5**	**6.5**	**66.3**	**2.2**	**3**
Rye flour:							
Minimum	12.4	0.6	6.0	0.4	77.6	0.8	......
Maximum	13.6	0.8	6.9	0.5	79.1	0.9	......
Average	**13.1**	**0.7**	**6.7**	**0.4**	**78.3**	**0.8**	**4**
Wheat flour, all analyses:							
Minimum	8.2	0.3	8.6	0.1	71.5	0.6	......
Maximum	13.6	0.7	13.6	1.0	78.5	1.8	......
Average	**12.4**	**0.5**	**10.8**	**0.2**	**75.0**	**1.1**	**20**
Buckwheat flour:							
Minimum	12.3	0.7	4.2	0.2	71.1	0.7	......
Maximum	17.6	1.3	8.1	0.5	79.4	1.8	......
Average	**14.6**	**1.0**	**6.9**	**0.3**	**75.8**	**1.4**	**4**
Ground linseed:							
Minimum	7.9	3.4	20.3	5.0	25.5	30.3	......
Maximum	8.3	6.1	23.0	9.6	30.2	30.5	......
Average	**8.1**	**4.7**	**21.6**	**7.3**	**27.9**	**30.4**	**2**
Pea meal:							
Minimum	8.9	2.6	19.1	11.1	50.2	0.9	......
Maximum	12.1	2.7	21.4	17.7	52.0	1.5	......
Average	**10.5**	**2.6**	**20.2**	**14.4**	**51.1**	**1.2**	**2**
Soja-bean meal	10.8	4.5	36.7	4.5	27.3	16.2	1
Ground corn and oats, equal parts:							
Minimum	10.7	1.9	8.4	....	[1]70.4	4.0	......
Maximum	13.1	2.7	10.4	....	[1]73.7	5.0	......
Average	**11.9**	**2.2**	**9.6**	....	[1]**72.0**	**4.4**	**6**
WASTE PRODUCTS.							
Corncob:							
Minimum	7.2	0.7	1.2	18.2	43.8	0.1	......
Maximum	24.8	2.7	3.7	38.3	66.7	0.9	......
Average	**10.7**	**1.4**	**2.4**	**30.1**	**54.9**	**0.5**	**18**
Hominy chops:							
Minimum	8.1	1.9	7.9	2.5	61.0	4.5	......
Maximum	13.5	3.1	11.2	6.7	71.1	11.2	......
Average	**11.1**	**2.5**	**9.8**	**3.8**	**64.5**	**8.3**	**12**
Corn germ:							
Minimum	9.4	1.9	9.7	1.9	61.9	5.2	......
Maximum	13.0	7.4	9.9	5.8	67.4	11.2	......
Average	**10.7**	**4.0**	**9.8**	**4.1**	**64.0**	**7.4**	**3**

[1] Including fiber.

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
WASTE PRODUCTS—continued.							
Corn-germ meal:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	6.5	0.8	10.0	7.8	57.4	4.3	......
Maximum	9.9	2.6	14.0	13.0	67.0	11.2	......
Average	**8.1**	**1.3**	**11.1**	**9.9**	**62.5**	**7.1**	**6**
Gluten meal:							
Minimum	6.2	0.5	21.3	0.3	34.0	3.4	......
Maximum	12.3	2.0	39.2	7.8	58.5	20.0	......
Average	**8.8**	**0.8**	**29.7**	**2.2**	**49.8**	**8.7**	**54**
Recent analyses—							
Minimum	6.2	0.5	21.4	0.6	34.0	6.6	......
Maximum	11.1	2.0	39.3	7.8	58.4	20.0	......
Average	**8.2**	**0.9**	**29.3**	**3.3**	**46.5**	**11.8**	**20**
Chicago[1]—							
Average	**10.1**	**1.1**	**30.1**	**1.6**	**48.7**	**8.4**	**6**
Buffalo[1]—							
Average	**8.2**	**0.8**	**23.3**	**6.1**	**50.4**	**11.2**	**5**
Cream gluten:							
Minimum	7.7	0.6	34.1	1.2	35.0	13.6	......
Maximum	9.0	0.8	38.2	1.3	41.1	15.8	......
Average	**8.1**	**0.7**	**36.1**	**1.3**	**39.0**	**14.8**	**3**
Gluten feed:							
Minimum	6.3	0.7	19.5	1.5	44.5	7.0	......
Maximum	9.0	1.8	28.3	8.2	58.0	12.6	......
Average	**7.8**	**1.1**	**24.0**	**5.3**	**51.2**	**10.6**	**11**
Buffalo[1]—							
Average	**7.7**	**1.1**	**25.0**	**5.3**	**49.3**	**11.6**	**5**
Pope's	14.0	0.6	33.3	1.6	36.5	14.1	1
Peoria[1]	7.5	0.8	19.8	8.2	51.1	12.6	1
Chicago maize feed:							
Minimum	8.6	0.7	19.3	6.8	49.2	5.6	......
Maximum	9.7	1.1	26.9	8.7	56.1	7.9	......
Average	**9.1**	**0.9**	**22.8**	**7.6**	**52.7**	**6.9**	**3**
Glucose feed and glucose refuse:							
Average	**6.5**	**1.1**	**20.7**	**4.5**	**56.8**	**10.4**	**2**
Dried starch feed and sugar feed:							
Minimum	9.2	0.6	17.1	3.1	49.2	7.3	......
Maximum	11.7	1.2	22.1	5.6	59.6	11.1	......
Average	**10.9**	**0.9**	**19.7**	**4.7**	**54.8**	**9.0**	**4**
Starch feed, wet:							
Minimum	62.3	0.1	3.6	1.6	18.7	1.3	......
Maximum	72.2	0.6	9.6	4.4	28.9	4.4	......
Average	**65.4**	**0.3**	**6.1**	**3.1**	**22.0**	**3.1**	**12**
Oat feed:							
Minimum	6.4	3.2	12.6	3.7	56.2	6.1	......
Maximum	9.2	4.2	20.0	12.5	63.7	7.8	......
Average	**7.7**	**3.7**	**16.0**	**6.1**	**59.4**	**7.1**	**4**
Barley screenings:							
Minimum	12.0	3.5	12.1	7.0	61.6	2.6	......
Maximum	12.4	3.6	12.5	7.6	62.0	2.9	......
Average	**12.2**	**3.6**	**12.3**	**7.3**	**61.8**	**2.8**	**2**
Malt sprouts:							
Minimum	7.3	3.8	21.0	9.3	45.5	1.0	......
Maximum	12.0	6.7	25.9	12.0	50.3	3.0	......
Average	**10.2**	**5.7**	**23.2**	**10.7**	**48.5**	**1.7**	**4**
Brewers' grains, wet:							
Minimum	68.6	0.3	4.3	3.1	9.6	0.8	......
Maximum	79.4	1.5	6.9	5.6	15.9	2.8	......
Average	**75.7**	**1.0**	**5.4**	**3.8**	**12.5**	**1.6**	**15**
Brewers' grains, dried:							
Minimum	6.2	3.3	19.3	10.2	46.1	4.2	......
Maximum	11.9	3.8	20.3	11.6	56.8	6.5	......
Average	**8.2**	**3.6**	**19.9**	**11.0**	**51.7**	**5.6**	**3**
Grano gluten	5.8	2.8	31.1	12.0	33.4	**14.9**	**1**
Rye bran:							
Minimum	8.2	2.9	11.5	2.5	59.8	**1.7**	......
Maximum	13.7	4.5	16.8	4.1	67.6	4.9	......
Average	**11.6**	**3.6**	**14.7**	**3.5**	**63.8**	**2.8**	**7**
Wheat bran from spring wheat:							
Minimum	7.4	4.0	14.3	5.4	51.7	**3.6**	......
Maximum	13.6	6.0	18.1	10.1	58.1	5.0	......
Average	**11.5**	**5.4**	**16.1**	**8.0**	**54.5**	**4.5**	**10**
Wheat bran from winter wheat:							
Minimum	10.6	5.0	13.9	7.2	50.5	**3.5**	......
Maximum	13.6	6.4	17.8	8.9	56.2	**4.5**	......
Average	**12.3**	**5.9**	**16.0**	**8.1**	**53.7**	**4.0**	**7**
Wheat bran, all analyses:							
Minimum	7.4	2.5	12.1	2.4	45.5	1.5	......
Maximum	15.8	7.8	18.9	15.5	63.2	7.0	......
Average	**11.9**	**5.8**	**15.4**	**9.0**	**53.9**	**4.0**	**88**

[1] Included in above average.

Composition of feeding stuffs—Continued.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Number of analyses.
WASTE PRODUCTS—continued.							
Wheat middlings:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Minimum	9.2	1.4	10.1	1.3	53.0	2.1	......
Maximum	16.0	6.3	20.0	12.7	70.9	5.9	......
Average	**12.1**	**3.3**	**15.6**	**4.6**	**60.4**	**4.0**	**32**
Wheat shorts:							
Minimum	4.1	2.0	11.1	6.0	50.0	2.5	......
Maximum	15.5	6.2	19.4	10.5	67.0	6.1	......
Average	**11.8**	**4.6**	**14.9**	**7.4**	**56.8**	**4.5**	**12**
Wheat screenings:							
Minimum	7.8	1.9	8.3	1.7	61.0	2.7	......
Maximum	13.6	3.8	16.9	7.5	70.4	3.3	......
Average	**11.6**	**2.9**	**12.5**	**4.9**	**65.1**	**3.0**	**10**
Rice bran:							
Minimum	8.8	8.4	10.9	2.0	41.9	5.2	......
Maximum	10.7	12.4	13.6	17.8	62.3	10.9	......
Average	**9.7**	**10.0**	**12.1**	**9.5**	**49.9**	**8.8**	**5**
Rice hulls:							
Minimum	7.7	10.5	2.9	30.3	36.0	0.6	......
Maximum	8.5	15.1	4.7	38.6	41.6	0.9	......
Average	**8.2**	**13.2**	**3.6**	**35.7**	**38.6**	**0.7**	**3**
Rice polish:							
Minimum	9.0	2.8	10.9	2.4	45.5	6.5	......
Maximum	11.2	11.3	12.9	14.5	63.3	8.0	......
Average	**10.0**	**6.7**	**11.7**	**6.3**	**58.0**	**7.3**	**4**
Buckwheat middlings:							
Minimum	9.5	4.4	25.1	2.4	36.3	5.7	......
Maximum	16.3	5.5	31.3	5.7	52.7	8.1	......
Average	**13.2**	**4.8**	**28.9**	**4.1**	**41.9**	**7.1**	**3**
Cotton-seed meal:							
Minimum	5.8	5.7	23.3	1.3	15.7	8.8	......
Maximum	18.5	8.8	50.8	10.1	38.7	18.0	......
Average	**8.2**	**7.2**	**42.3**	**5.6**	**23.6**	**13.1**	**35**
Cotton-seed hulls:							
Minimum	9.2	1.8	2.2	37.9	12.4	0.6	......
Maximum	16.7	4.4	5.4	67.0	41.8	5.4	......
Average	**11.1**	**2.8**	**4.2**	**46.3**	**33.4**	**2.2**	**20**
Linseed meal, old process:							
Minimum	5.6	4.6	27.7	4.7	28.4	5.2	......
Maximum	12.4	8.2	38.2	12.9	41.9	11.6	......
Average	**9.2**	**5.7**	**32.9**	**8.9**	**35.4**	**7.9**	**21**
Linseed meal, new process:							
Minimum	6.0	5.0	27.1	7.6	35.2	1.3	......
Maximum	13.4	6.9	38.4	4.0	48.0	4.4	......
Average	**10.1**	**5.8**	**33.2**	**9.5**	**38.4**	**3.0**	**14**
Peanut meal:[1]							
Minimum	6.6	3.7	37.5	2.5	28.5	5.8	......
Maximum	15.4	5.5	52.4	7.4	30.8	17.5	......
Average	**10.7**	**4.9**	**47.6**	**5.1**	**23.7**	**8.0**	**2,480**
Peanut hulls:							
Minimum	7.8	1.9	4.6	56.5	9.7	0.9	......
Maximum	10.8	4.6	8.6	72.3	18.9	2.0	......
Average	**9.0**	**3.4**	**6.6**	**64.3**	**15.1**	**1.6**	**5**
MILK AND ITS BY-PRODUCTS.							
Whole milk:							
Minimum	80.3	0.4	2.1	......	2.1	1.7	......
Maximum	90.7	1.2	6.4	......	6.1	6.5	......
Average	**87.2**	**0.7**	**3.6**	......	**4.9**	**3.7**	**798**
Skim milk, cream raised by setting:							
Minimum	88.3	0.5	2.6	......	3.8	0.2	......
Maximum	92.6	1.0	3.9	......	5.5	2.5	......
Average	**90.4**	**0.7**	**3.3**	......	**4.7**	**0.9**	**96**
Skim milk, cream raised by separator:							
Minimum	89.8	......	......	......	......	......	......
Maximum	91.2	......	......	......	......	......	......
Average	**90.6**	**0.7**	**3.1**	......	**5.3**	**0.3**	**7**
Buttermilk:							
Minimum	82.2	0.4	1.7	......	2.5	......	......
Maximum	93.3	0.9	6.2	......	5.6	5.4	......
Average	**90.1**	**0.7**	**4.0**	......	**4.0**	**1.1**	**85**
Whey:							
Minimum	93.2	0.3	0.3	......	4.4	0.0	......
Maximum	94.6	0.6	1.2	......	5.8	0.2	......
Average	**93.8**	**0.4**	**0.6**	......	**5.1**	**0.1**	**46**

[1] Mostly European analyses.